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Viability Assessment Report
For
Dry-Mesic Mixed Pine-Oak Habitat Association

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I. Description of Habitat Association

The Dry-Mesic Mixed Pine-Oak Habitat Association can be found to some degree throughout the Daniel Boone National Forest (DBNF). While represented on all districts, it is most common on the southern portions of the forest. Over 88 percent of the acres classed in this habitat association are located on the London, Somerset, and Stearns districts (USDA Forest Service, 1998). This habitat association can be found in several Land Type Associations (LTAs) but it is most common in the Southern Cliff (221Hc003), Rockcastle Hills (221Hc005), London-Corbin Plain (221Hc006) and Big South Fork Plateau (221Hc004) LTAs. It is also relatively common in the Central Cliff (221Hb002), Northern Rolling Low Hills (221Hb005), London-Corbin Plain Transition (221Hc007), and along the Northern Escarpment (221Hb004) LTAs (USDA Forest Service, 1997a).

This habitat association may occur in a variety of topographies. It is most typically found on sandstone and shale ridgetops and slopes with a northerly or easterly aspect (Jones, 1988). It may, however, occur on any slope and extend into drainages and flat bottomland areas. Soils typically have a somewhat loamy subsurface horizon, coarse texture, and are well drained. Soil depths generally run from 5 to 40 inches on the ridges and 40 plus inches on the slopes. Most sites will grade into mesic oak, southern yellow pine or xeric pine-hardwood sites (SAMAB, 1996; Jones, 1988).

This association is a mix of yellow pine-hardwood and hardwood-pine stands occurring on dry to somewhat mesic sites and will typically have from 31 to 69 percent yellow pine in the overstory (USDA Forest Service, 1998). The ratio of pine and hardwood species is largely a product of the past disturbance regimes. The presence of hardwoods dominating many mixed stands is likely due to the absence of historic disturbance regimes and changes in land use in the majority of the sites over the past 75 to 100 years. Whereas past disturbance caused by more Native American burning, frequent wildfires and historic use of these sites for farming, grazing or heavy timber harvest may have encouraged the regeneration of shade-intolerant oaks and pines, more recent events such as the suppression of fires and succession of these sites to mature forest has favored shade-tolerant hardwoods other than oaks. The inclusion of more mesic sites in this habitat association may also explain the abundance of hardwoods in many of these mixed stands.

Overstory species that commonly occur in this habitat association include: shortleaf pine, pitch pine, white oak, chestnut oak, black oak, northern red oak, southern red oak, pignut hickory, mockernut hickory, and yellow poplar (and historically, American chestnut). Midstory associates include sourwood, redbud, sassafras, dogwood, blackgum, and red

maple. The shrub layer is typically ericaceous with blueberry, huckleberry, and laurels dominating the drier sites along with false Solomon's seal and wild geranium in the more mesic sites (USDA Forest Service, 1997; Jones, 1988). In mature stands, the midstory may be rather dense and well developed unless the site has been repeatedly burned or disturbed in some way that reduces the midstory component. The understory may be of moderate to low density and dominated by shade tolerant species due to closed canopy conditions. Exceptions are found where wide canopy breaks occur from natural disturbances or repeated burning.

II. Current Status of the Habitat Association on the Daniel Boone National Forest

Prior to the 2000-2001 southern pine beetle (SPB) epidemic, the DBNF had approximately 67,705 acres of forest area in the Dry-Mesic Mixed Pine-Oak Habitat Association (USDA Forest Service, 1998). This represented about 10 percent of the total forested area on the DBNF. However, it is believed that approximately 75 to 90 percent of the pine component has been killed as a result of the SPB epidemic. As a result, it is likely that approximately 2 percent of the total forested area on the DBNF is now in this habitat association. In 1998, approximately 61 percent (41,320 acres) of this was greater than 70 years old and the age classes less than 30 years old represented approximately 19 percent (12,909 acres) of this association.

On the DBNF, this association is typically thought of as a pine-hardwood group dominated by shortleaf pine-oak species. However, prior to the SPB epidemic, 55 percent of this association was classed as hardwood-pine where hardwoods represent 51 to 69 percent of the dominant and co-dominant species. Today, much more than 55 percent (due to the recent pine mortality) is likely to fall within hardwood-pine forest types.

Most of the mixed pine-oak stands that fall within this habitat association contain little or no advanced oak or shortleaf/pitch pine regeneration in the midstory or understory. This is likely a result of fire-suppression and lack of other disturbances that would allow adequate light to reach the understory layer and stimulate oak and pine regeneration. As a result, the midstory layer of these stands is composed of high densities of species such as dogwood, redbud, red maple and yellow poplar. The understories of these stands are generally completely shaded and contain shade-tolerant shrubs and herbaceous plants.

On the southern portion of the forest where this association occurred most frequently, or graded into other pine dominated associations, this association comprised a major portion of the lands considered suitable for red-cockaded woodpecker (RCW) recovery. Although stands with a higher component of hardwoods are less suitable for RCW use, many of the stands contained a sufficient amount of yellow pine to provide suitable foraging and nesting areas. This association usually occurs on sites with fair to good timber productivity and therefore it has historically been managed to some degree for wood production.

The devastation from the SPB epidemic has caused the loss of the yellow pine component in many of these formerly mixed pine-oak stands and will transform formerly mixed stands to sites dominated by hardwoods. Today, most of these sites would not be classified as mixed forest types because they do not contain at least 30 percent live yellow pine. This habitat association currently consists primarily of young regeneration areas not yet impacted by the

SPB and small, scattered areas of mature to mid-age mixed pine-hardwood that are quickly being transformed into hardwood-dominated areas.

III. Management Needs: Recommendations for the Conservation of Habitat to Ensure Species Viability

A. Purpose and Need for Management of Dry-Mesic Pine-oak Communities

Recognition and management of mixed pine-hardwood types can produce a number of benefits. Since the DBNF occurs within the range of several hardwood and yellow pine species, many sites on the forest are well-suited to providing conditions conducive to growing healthy stands of both yellow pine and desirable hardwoods. As a result, many sites in the forest have likely been historically composed of a mix of pine and hardwood species. This in-stand diversity of tree species composition, which provides a mix of conifers and deciduous hardwoods, has resulted in a high diversity of plants and animals within these stands. Many of these wildlife and plant species (including those in Attachment A) find suitable conditions within these stands because they are attracted to either the yellow pine or the deciduous hardwood component of these stands, or in many cases, to the disturbance regime (often, fire) that often maintains the mixed pine-oak stand composition.

Within the Dry-Mesic Mixed Pine-Oak Habitat Association, the following conditions are needed to ensure persistence of species identified in Attachment A:

Acidic substrate	Elevations above 2300’	Leaf Litter	Open Canopy	Snags > 6” and > 20” dbh
SE to NW Aspect	Ericaceous shrubs	Mature Forest	Open Midstory/ Understory	Snags of any size
Dense Shrub Understory	Periodic burning	Mid-age Forest	Rich soil	Water nearby
Downed Logs	Forb/Grass Conditions	Moderate Shade	Rocky areas	Large tracts of suitable habitat
Good Drainage	Minimal forest edge/Interior Habitat	Moist Conditions	Sandy Soils	Trees with Cavities
Poor Drainage	High Shade	Old Growth Conditions	Shrub/Sapling Conditions	Trees > 20” dbh
Dry Conditions	Large Decadent Trees	Open (Little or no shade) areas	Slopes/Steepness	Upland Areas

Many of these conditions (such as sandy soils, slope, drainage) are factors of geology and topography and not normally influenced by standard forest management activities. Where forest management activities may influence these conditions, however, standards and guidelines are presented in this analysis to ensure that these conditions continue to be

present within the Dry-Mesic Mixed Pine-Oak Habitat Association in order to ensure the persistence of species identified in Attachment A.

B. Desired Future Condition

AGE CLASS

To provide for the greatest diversity and meet requirements of all species listed in Attachment A, a variety of age classes within this habitat association are recommended. The conditions represented by these various age classes provide important habitat conditions for the species listed in Attachment A. For example, maintaining a component of this habitat association in the 0 to 10 year old age class would provide for species that require patches of bare ground, thickets, briars, vines and forbs, whereas, a 10 to 30 year old component would better serve species that require taller, more dense, woody, shrubby early successional habitat. Species that simply require brushy conditions, regardless of stem density or type would be provided by both the 0 to 10 year and 10 to 30 year component of this habitat association. Species that only prefer a component of this habitat association in a forested condition that is dominated by trees of varying heights and densities but do not require older trees for mast production and cavities or snags would need a component of this habitat association greater than 20 years of age. Species most dependent upon mature stands that provide cavity trees, large snags, and production of acorns and pine seed would be best provided for by maintaining a component of this habitat association greater than 80 years of age.

However, it is also recognized that the DBNF is currently well below the desired levels of 20 plus year old mixed forest types and has an unbalanced age class distribution of mixed forest types as a result of the SPB epidemic. The desired age class distribution is based upon the viability needs of all the species in Attachment A and would ensure persistence of all these species within the dry-mesic pine-oak community (assuming other recommendations made in this analysis are implemented). However, because of the SPB epidemic, it will be impossible to achieve this desired age class distribution within the next planning period. The age class distribution over the next planning period is more likely to reflect an increase in the 0 to 10 year old age class and a decrease in the 20 plus

The desired age class distribution of dry-mesic mixed pine-oak habitat.

Desired Successional Class	percent desired in pine-hardwood forest types*	percent desired in hardwood-pine forest types*
Forest 0-10 years of age	~6 percent (1998-pre SPB levels)	~5 percent (1998 levels-pre SPB)
Forest 0-30 years of age	~27 percent (1998-pre SPB levels)	~16 percent (1998-pre SPB levels)
Forest 20-80 years of age	~45 percent (1998-pre SPB levels)	~50 percent (1998-pre SPB levels)
Forest 80 plus years of age	~42 percent (1998-pre SPB levels)	~42 percent (1998-pre SPB levels)

*Rationale for using 1998 levels: Monitoring of some species that are identified in Attachment A (primarily birds) immediately before, during and after 1998 did not reveal any significant declines of these species during that time period, therefore, it is assumed that age class distributions that existed during that time period were adequate in ensuring persistence of these species on the forest and within this habitat association.

year old age class for this habitat association. As a result, the age class distribution expected over the next planning period is not likely to provide for short term persistence of all these species on the DBNF, particularly those species that require large tracts of mature pine-dominated forest. This desired age class distribution will provide for the following habitat conditions within the Dry-Mesic Mixed Pine-Oak Habitat Association: Dense shrub understory, large decadent trees, mature forest, mid-age forest, old growth conditions, shrub/sapling conditions, and trees > 20" dbh.

OVERSTORY

The overall landscape composition of the DBNF is based upon many influences. Based upon existing forest structure and needs of species identified in Attachment A, the desired forest composition of dry-mesic pine-oak habitat is as follows:

Desired level of DBNF that will be in a dry-mesic pine-hardwood forest type	4.5 percent 1998 1 percent likely in 2001 (-3.5 percent) 4-6 percent desired
Desired level of DBNF that will be in a dry-mesic hardwood pine forest type	5.6 percent 1998 9.1 percent likely in 2001 (plus3.5 percent) 4-6 percent desired
Total desired level of DBNF that will be in a dry-mesic pine-oak Habitat Association	10 percent in 1998 10 percent likely in 2001 6-8 percent desired

These desired levels are based upon the assumption that the recommendations outlined in this analysis are implemented. Implementation of these recommendations will help assure persistence of the species identified in Attachment A.

MIDSTORY AND UNDERSTORY

It is desired that mixed pine-oak stands be somewhat self-sustaining. This will require the use of techniques, primarily burning and thinning, that will encourage advanced pine and oak regeneration in the understory and create a somewhat open midstory. The use of these techniques will likely create a midstory that contains species such as dogwood, sourwood, sassafras and blackgum and an understory of sedges, grasses, grapes, bracken fern, ericaceous shrubs such as huckleberries and blueberries, and mountain laurel. In the more mesic pine-oak sites, the midstory and understory would be expected to be less open and likely to contain more shade-tolerant species such as red maple and yellow poplar with an understory dominated more by deciduous shrubs and herbaceous plants.

General Strategy to be Used to Meet Desired Future Condition (DFC):

The general strategy that should be taken to achieve the Desired Future Condition is to implement future management that will favor oak in existing or historical hardwood-pine stands and pine in existing or historical pine-hardwood stands. This may lead to some stands becoming >70 percent hardwood or pine and being reclassified as upland hardwood forest types or southern yellow pine types rather than "mixed" forest types. An

exception to this will likely occur in cases where existing and historical hardwood-pine sites are contiguous with areas being managed for species that require large tracts of pine forest. Where the latter occurs, many of these hardwood-pine sites may be managed towards pine-hardwood types (50-69 percent pine) or will maintain their hardwood-pine classification.

C. Habitat Association General Direction and Standards and Guidelines

Forest-wide

General Direction: Create healthy dry-mesic pine-oak communities.

- Emphasize prescribed fire use in mixed forest types.
    - *Rationale: Extensive research has shown that both the pine and oak components of pine-oak stands respond favorably to somewhat open conditions created by burning and the reduction of less fire tolerant woody competition. Open conditions created by burning also benefit species identified in Attachment A that require an open canopy, open midstory/ understory, or are fire dependent/enhanced, and helps maintain an ericaceous and/or forb grass condition in the understory.*

- Implement periodic maintenance burns, including during the growing season to control undesirable woody vegetation in mixed forest types. (RCW FEIS).
    - *Rationale: Growing season burns will likely be the most effective in reducing undesirable hardwood stem density in the understory.* Consider restoration of American chestnut in sites that lend themselves to this objective.
    - *Rationale: American chestnut was historically a species dominant in the overstory of this Habitat Association.*

- Provide downed logs and large woody debris on the forest floor where this may be limited naturally.
    - *Rationale: Some species require the presence of down logs on the forest floor within this habitat association and where the presence of down logs is not provided due to natural events or as a result of forest management activities, there should be an attempt made at restoring this habitat condition.*

General Direction: Maintain or restore shortleaf or pitch pine dominance within existing and historical pine-hardwood stands.

- *Rationale: Ensuring a pine dominance in pine-hardwood stands will contribute to the overall availability of yellow pine across the landscape in levels that will provide for the persistence of species that are restricted or dependent upon the presence of stands of pines and other conifers. Shortleaf and pitch pines are the desirable pine species because they are longer lived than Virginia pine and can*

provided habitat for species associated with the dry-mesic pine-oak community over a longer period of time than Virginia pine-oak sites may provide.

- Where pine-hardwood stands are considered not adequately stocked to maintain a > 50 percent pine overstory dominance, implement management that will increase the pine stocking in the understory using a variety of methods such as controlled burning, planting, releasing advanced regeneration, and other methods that may be applicable.

  - *Rationale: Stands that contain less than 50 percent pine overstory would not be considered pine-hardwood forest types. It is important to maintain a pine dominance in some of these mixed stands in order to provide for species that require contiguous pine habitat and for species that a restricted to pines for foraging purposes (such as red-cockaded woodpecker). Periodic burning will produce a better seedbed for pine regeneration and limit competition from species that are less tolerant of burning that pines. Also improves habitat for fire-tolerant/enhanced species. If burns are conducted prior to pine seed dispersal, there is a greater chance that seed will fall on a site where it can successfully sprout and remain viable. If burning cannot occur during this time, then burns should focus on limiting the amount of non-desirable sprouts within the pine-hardwood stands in order to maintain pine dominance in these sites. Once pine stocking levels in the understory become adequate, controlled burning should be curtailed to allow pine seedlings time to grow. Once pine stocking in the understory reaches the desired level to maintain a >50 percent pine dominance, burning should be curtailed so that young seedlings have a chance to grow without being killed back by other burns. Pine regeneration generally needs to be released from hardwood competition, especially in mixed sites.*

- Conduct site prep activities that will provide the best results for desired pine regeneration such as implementing spring to early summer felling of non-desirable residuals that are > 5 feet tall and allowing felled residuals to be allowed to dry until early to mid-July before burning (Phillips and Abercrombie, 1987). Consider use of herbicides or low intensity burning treatments to release pine seedlings.

  - *Rationale: Site prep at this time will coincide with timing for better site prep burns and follow-up planting. Allowing residuals to "cure" for a few months will improve the effectiveness of a follow-up site prep burn. Studies show that burning after July 1 has the greatest effectiveness on preparing a site for planting that following winter and maximizes the consumption of residual slash on the ground that could impede planting efforts and successful pine regeneration. By planting after the burn, planting is easier to do and the seedlings have less competition from other species. Also, planting in the winter and early spring is the best time for seedlings to get established. Following planting, some sites may need follow-up treatments to ensure that pine seedling are not out competed by less desirable species.*

- A variety of regeneration methods may be used to restore or regenerate pine-hardwood forest types, the most appropriate of which is to be determined by site-specific objectives and needs.

    - *Rationale: Regeneration of some pine-hardwood forest types will provide habitat for those species that require early successional forest as well as interior forest edge conditions.*

- All healthy shortleaf and pitch pines should be retained during stand restoration activities, unless their density is greater than 70 square feet of basal area, in which case the desired trees should be thinned to improve pine regeneration in the understory and improve the health of the stand. (RCW FEIS)

    - *Rationale: "Restoration" implies that a shortleaf and pitch pine composition will be restored to the site. If there is already a component of this desired species in the stand, it should be retained, where it may provide a natural seed source, etc., unless its retention hampers further restoration of the site to a desired pine-hardwood type.*

- Maintain a pine basal area of 40-110 square feet, depending on site and stand condition and site objectives

    - *Rationale: Depending upon objectives for the site, the BA may be relatively low (40-50 BA if the site is managed as a pine-oak barrens, for instance) or it may be relatively high (80-110 BA if the site is being managed to provide dense conifer cover, or is in regeneration and densely stocked). An average BA of 40-110 (around 70BA) would be desired in the majority of pine-hardwood sites. Varying the basal area of stands will also provide a variety of shade conditions.*

General Direction: Maintain or restore an oak component within existing and historical hardwood-pine stands.

    - *Rationale: Maintaining an oak component in these stands will ensure persistence of those plant and animal species that require the hardwood component of a mixed forest type, particularly oak, as well as species that require leaf litter on the forest floor.*

- A variety of regeneration methods and site prep techniques may be used to restore or regenerate desired oak species while maintaining a mixed pine-oak composition, the most appropriate of which is to be determined by site-specific objectives and needs.

    - *Rationale: Regeneration of some hardwood-pine forest types will provide habitat for those species that require early successional forest as well as interior forest edge conditions.*

        1. Even-aged management is generally the preferred regeneration method for regenerating oaks in mixed forest types.

- *Rationale: Studies indicate that oaks require high amounts of sunlight for successful regeneration, and these conditions are best provided in even age management areas. Even-aged management will provide habitat for species that require larger stands (generally > 10 acres) of early successional forest habitat and for species that occupy areas with dense shrub understories .*

a) Clearcutting is the preferred method on relatively dry sites but relatively unsuccessful on mesic sites (Thompson and Dessecker, 1992).

- *Rationale: Studies have shown that clearcutting on mesic hardwood-dominated sites often accelerates the site towards a mixed mesophytic community because more mesic sites generally have less advance oak regeneration in the understory than drier sites. Drier sites generally have a greater accumulation of natural oak reproduction in the understory, which is favored by clearcutting.*

b) Shelterwoods are useful on more mesic sites where advanced oak regeneration is present (Thompson and Dessecker, 1992).

- *Rationale: Shelterwoods are more useful on mesic sites that have less advanced oak regeneration in the understory because it controls stand density near the end of rotation when oak reproduction needs to accumulate.*

2. Uneven age management may be considered where even aged management does not meet site objectives.

- *Rationale: Implementing uneven aged management may allow for regeneration of pine-oak sites while still maintaining some of the overstory and some of the attributes of mature stands. Generally, however, uneven aged management does not provide many of the attributes of early successional habitat. Uneven-aged management may provide for species that will persist in small areas (generally < 2 acres) of early successional forest or for species that require some overstory trees with an early successional, dense, shrubby understory.*

a) **Group selection** cuts may be used providing that group selection cut openings are at least 1/10 of an acre in size (depending upon amount of advanced oak regeneration on site) (Thompson and Dessecker, 1992).

- *Rationale: Creating openings will provide necessary light to facilitate growth of advanced oak reproduction in these sites as long as openings fall within 1/10 – ½ acre in size. Larger openings should be referred to as patch cuts or clearcuts.*

3. Controlled burning should be timed for early fall immediately preceding acorn seed dispersal from the overstory. Otherwise, burns should be conducted at times when maximum bud and sprout mortality of non-desirable hardwoods will occur.

    - *Rationale: If burns are conducted prior to acorn dispersal, there is a greater chance that acorns will fall on a site where it can successfully sprout and remain viable. If burning cannot occur during this time, then burns should focus on limiting the amount of non-desirable sprouts within the hardwood-pine stands in order to maintain oak dominance in these sites.*

4. Retain some mature oaks in regeneration stands to sustain acorn production.

    - *Rationale: Retaining mature oaks in regeneration stands will provide for species that feed on acorns and prefer mature oaks in a very sparse, open canopy condition and will also provide a natural seed source for oak regeneration.*

5. Reduce competition from non-desirable hardwood species thru a variety of methods such as controlled burning and/or herbicide use. This may be especially necessary on sites that have a Site Index > 70 for black oak (Schlesinger, 1993).

    - *Rationale: On hardwood-pine sites with higher site indices, there may be sufficient competition from other hardwood species to out compete the more desirable oak species. Burning, overstory release and herbicide use have all been shown to retard the development of competing non-oak saplings. Release, particularly overstory release, should be conducted when oak seedlings are at least 4.5 feet tall (Schlesinger, 1993). Studies show that oaks of less than 4.5 feet tall generally are not big enough to out compete other nondesirable hardwood saplings in a site.*

General Direction: Provide large cavity trees and snags in mature dry-mesic pine-oak communities.

- *Rationale: For some species identified in Attachment A, the presence of large cavity trees and snags in the dry-mesic pine-oak community is necessary for their persistence within that community. This standard and guideline will provide for the presence of cavity trees and snags within this habitat association.*

- Establish rotation ages that will ensure that mature, heart-rotted, and large diameter yellow pines and oaks are provided on the landscape.

    - *Rationale: By increasing the rotation age, a supply of old, decadent, heart-rotted pines and oaks should be available for species that require these kinds of trees for nesting, foraging or perching. This provides the condition of large decadent trees within this habitat association.*

- Existing pine and pine-hardwood stands of desirable pine type will not be regenerated until they reach rotation age, but thinning may occur in these stands. If regeneration of pine and pine-hardwood types is necessary to help achieve a balanced age class, regeneration may occur, but not in the oldest 1/3 of pine and pine-hardwood stands (RCW FEIS).

  ◦*Rationale: By retaining the oldest 1/3 of pine and pine-hardwood stands, species that require mature pine-dominated forest and older, mature pines should be provided for. Thinning will also provide moderate shade conditions for some species.*

- Provide artificial cavities and nest boxes for species that may be limited by cavity availability.

  ◦ *Rationale: Artificial cavities and nest boxes can provide nesting and roosting habitat for species that may be limited by the unavailability of snags and den trees within the dry-mesic pine-oak communities.*

- Retain existing snags in project areas except where they would interfere with project purpose and need.

  1. No snags will be intentionally felled within project areas associated with timber management.

     ◦ *Rationale: This will insure that deliberate attempts to reduce the snag component within timber management areas will not occur and help ensure the presence of snags of any size within this habitat association.*

  2. Within project areas, at least three snags per acre at least 9" dbh will be retained.

     ◦ *Rationale: This will help insure that larger diameter snags > 6" and > 20" dbh will be provided in project areas that fall within dry-mesic pine-oak forest types.*

  3. Live trees will be girdled if the existing density of standing dead trees does not meet this standard.

     ◦ *Rationale: This will provide suitable snags in areas where snag availability may be limited.*

  4. Snags considered to be immediate threats to human safety may be removed anytime. Those not identified as immediate hazards should be removed during the Indiana bat hibernation season.

     ◦ *Rationale: This will protect species that may be using snags for breeding purposes.*

General Direction: Provide contiguous pine-dominated habitat for forest-interior pine-dependent species on the London, Somerset and Stearns Districts.

- *Rationale: Some species require large tracts of contiguous pine dominated habitat. Habitat requirements for these species would be best met on the London, Somerset and Stearns District because the southern part of the forest provides the greatest numbers of sites suitable for restoration and/or maintenance of the dry-mesic pine oak community*.

- Emphasize pine management in existing and/or historical hardwood-pine stands that are on the south end of the forest and are determined to be important links necessary for maintaining continuity of large tracts of contiguous pine dominated habitat.

  - *Rationale: Where habitat for species requiring contiguous and interior pine dominated habitat in large tracts, the conversion of hardwood-pine sites to pine-hardwood sites should be considered since often, these hardwood-pine sites are located adjacent to pine dominated stands are contain suitable site characteristics that make them suitable for either pine or hardwood dominance.*

- Limit regeneration patch sizes in pine and pine-hardwood forest types:

  - *Rationale: Patch size on the south end of the forest within pine dominated forest types should be limited because the south end of the forest offers the best and only potential for providing habitat for species that require large tracts of mature pine dominated forest.*

  1. Regeneration patch size for *restoration* of pine or pine-hardwood forest types will not exceed 40 acres (RCW FEIS)

     - *Rationale: It is understood that for restoration purposes, there will be a need to accelerate regeneration of these forest types and increasing patch size is one method of doing that.*

  2. Regeneration within pine or pine-hardwood forest types for *non-restoration* purposes will not exceed 25 acres (RCW FEIS and current FMP)

     - *Rationale: Limiting patch size will help maintain the continuity of mature pine-hardwood forest types.*

- Avoid creation of permanent or temporary barriers that inhibit or prevent movement of forest-interior pine-dependent species between areas of activity.

  - *Rationale: The creation of permanent and temporary barriers on the south end of the forest within pine dominated forest types should be limited because the south end of the forest offers the best and only potential for providing habitat for species that require large tracts of mature pine dominated forest and habitat for these species could be fragmented by the unlimited creation of permanent or temporary barriers.*

- Provide some overstory pine habitat within regeneration areas.

    - *Rationale: Because the south end of the forest offers the best and only potential for providing habitat for species that require large tracts of mature pine dominated forest, the retention of some pine habitat within the overstory of regeneration areas may provide for a mature pine component within these stands and mitigate the potentially fragmenting effects to mature pine dominated habitat that could occur were no mature pine overstory retained.*

- Regeneration areas where contiguous habitat for forest-interior pine-dependent species may be limited will retain 40 square feet of pine basal area when it is available (RCW FEIS)

    - *Rationale: Maintaining a 40 BA of pine will maintain attributes of a mature pine-hardwood stand while also allowing stand regeneration.*

        1. Trees retained should be selected in the following order:

            -relict trees,

            -other potential cavity trees,

            - *Rationale: Retention of these trees will ensure that trees most likely to develop heartrot and provide habitat for cavity dependent species are provided.*

            -other trees > 10” that represent the best seed producers (RCW FEIS)

            - *Rationale: Retention of these trees will provide the best natural seed source for the stand to be regenerated.*

IV. Management Needs: Monitoring and Inventory to Ensure Species Viability

There are basically no species listed in Attachment A that would fail to persist on the DBNF if the Dry-Mesic Mixed Pine-Oak Habitat Association was not maintained on the Forest, **as long as** southern Yellow Pine and Dry-Mesic Oak Habitat Associations are provided. Because the DBNF is a hardwood-dominated forest overall, those species identified in Attachment A that are attracted to the hardwood component of dry-mesic pine-oak habitats would not likely be greatly affected by loss of this habitat association on the Forest. However, the presence of pine and open, fire-maintained habitat is a more limiting factor on the DBNF and many species would persist in much lower numbers on the DBNF if the sites recommended in this analysis for pine-hardwood management were converted to hardwood-dominated systems or were not maintained by some level of burning. For this reason, it is recommended that species that are most dependent upon the pine and fire component of this Habitat Association be monitored. Those species are:

Pine warbler, Red-cockaded woodpecker, Pitch pine

These two bird species are currently being monitored on an annual basis through the DBNF's implementation of the Southern National Forests' Migratory and Regional Landbird Conservation Strategy, as well as thru the use of roadside point counts and it is recommended that this monitoring continue and be given high priority to ensure our awareness of persistence of these species. Currently, the DBNF monitors the presence of pitch pine and other tree species in its ongoing CISC and it is recommended that this continue on a regular basis.

The condition of the dry-mesic pine-oak community should also be monitored by including attributes such as midstory density, understory description and condition, and a past history of stand treatments as part of the regular field inventory of stands. High priority should be given to conducting field inventories to gain data on a number of stand/site attributes such as soil conditions, slope, aspect, dominant and codominant stem densities, midstory and understory composition, and estimation of site quality. Utilize existing databases such as CISC, Forest Inventory, as well as GIS spatial data, aerial photographs, historical land use patterns, etc. Utilize Forest Service Ecological Classification System descriptions of Landtypes and Landtype Phases, which are based largely upon material outlined by Smalley (1983; 1984; 1986). Prior to making decisions that affect stand composition of individual sites on the forest, this information should be gathered to provide guidance as to what management decisions would be best for restoring or maintaining a dry-mesic pine oak community on a particular site, or in some cases, to justify management of the site for some other habitat association.

Monitoring should also be conducted the summer following burning to determine natural pine and oak stocking as a result of burning activities. This monitoring is of medium priority but will reveal whether or not the burn reached the objective of improving pine or oak viability in the site or had a negative effect upon the stand and its desired condition.

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Attachment A.

Species List: Dry-Mesic Mixed Pine-Oak

Class	Common Name/ Species
ANIMALS	
Birds	Sharp-shinned Hawk/ *Accipter striatus*
	Bachman's Sparrow/ *Aimophila aestivalis*
	Chuck-will's Widow/ *Caprimulgus carolinensis*
	Eastern Wood-Pewee/ *Contopus virens*
	Cerulean Warbler/ *Dendroica caerulea*
	Prairie Warbler/ *Dendroica discolor*
	Yellow-throated Warbler/ *Dendroica dominica*
	Blackburnian Warbler/ *Dendroica fusca*
	Pine Warbler/ *Dendroica pinus*
	Least Flycatcher/ *Empidonax minimus*
	Acadian Flycatcher/ *Empidonax virescens*
	Worm-eating Warbler/ *Helmitheros vermivorus*
	Wood Thrush/ H*ylocichla mustelina*
	Swainson's Warbler/ *Limnothlypis swainsonii*
	Red-headed Woodpecker/ *Melanerpes erythrocephalus*
	Kentucky Warbler/ *Oporonis formosus*
	Red-cockaded Woodpecker/ *Picoides borealis*
	Summer Tanager/ *Piranga rubra*
	Ovenbird/ *Seiurus aurocapillus*
	American Redstart/ *Setophaga ruticilla*
	Red-breasted Nuthatch/ *Sitta canadensis*
	Yellow-throated Vireo/ *Vireo flavifrons*
Insects	Appalachian Grizzled Skipper/ *Pyrgus wyandot*
	Diana Fritillary/ *Speyeria diana*
	Regal Fritillary/ *Speyeria idalia*
Reptiles	Northern Coal Skink/ *Eumeces antracinus anthracinus*
	Southern Five-lined Skink/ *Eumeces inexpectatus*
	Eastern Slender Glass Lizard/ *Ophisaurus attenuatus longicaudus*
	Northern Pine Snake/ *Pituophis melanoleucus melanoleucus*
	Southeastern Crowned Snake/ *Tantilla coronata*
PLANTS	
Dicots	Eastern Silvery Aster/ *Aster concolor*
	American Chestnut/ *Castanea dentata*
	Chinquapin (generic)/ *Castanea pumila*
	Allegheny Chinquapin/ *Castanea pumila* var. *pumila*
	Scarlet Indian Paintbrush/ *Castilleja coccinea*

Class	Common Name/ Species
	Small-flowered Thoroughwort/ *Eupatorium semiserratum*
	Box Huckleberry/ *Gaylussacia brachycera*
	Red-disked Sunflower/ *Helianthus atrorubens*
	Smooth Veiny Peavine/ *Lathyrus venosus*
	Carolina Anglepod/ *Matelea carolinensis*
	American Cow Wheat/ *Melampyrum lineare*
	American Cow Wheat/ *Melampyrum lineare* var. *pectinatum*
	Sweet Pinesap/ *Monotropis odorata*
	Gaywings/ *Polygala pauciflora*
	Racemed Milkwort/ *Polygala polygama* var. *polygama*
	Hairy Snout Bean/ *Rhynchosia tomentosa*
	Slender Marsh-pink/ *Sabatia campanulata*
	American Chaffseed/ *Schwalbea americana*
	Big-flowered Snowbell/ *Styrax grandiflorus*
	Spiked Hoary-pea/ *Tephrosia spicata*
	Bird's-foot Violet/ *Viola pedata*
Gymnosperms	Ground Juniper/ *Juniperus communis* var. *depressa*
	Pitch Pine/ *Pinus rigida*
Liverworts	A liverwort/ *Nowellia curvifolia*
Monocots	Grass-pink/ *Calopogon tuberosus*
	Boott's Caric Sedge/ *Carex picta*
	Appalachian Spreading Pogonia/ *Cleistes bifaria*
	Spotted Coralroot/ *Corallorrihiza maculata*
	Pink Lady-slipper/ *Cypripedium acaule*
	Bearded Skeleton Grass/ *Gymnopogon ambiguus*
	Wood Lily/ *Lilium philadelphicum* var. *philidelphicum*
Mosses	Dog Paw Moss or Elegant Moss/ *Dicranum scoparium*

Attachment B.

Dry-Mesic Mixed Pine-Oak Habitat Association Species/Habitat Relationships with References

ANIMALS

Birds

Sharp-shinned Hawk – *Accipiter striatus* – This species would be attracted primarily to the pine component of mixed pine-oak forest, primarily for nesting purposes. During the year, sharp-shinned hawks utilize both hardwoods and conifers and, in general, are most abundant in areas where a mixture of tree types exists. Although they are known to nest in hardwoods, birds in Kentucky seem to prefer evergreens for nesting and overwintering. A large, mature pine is a typical nesting site, provided it is within an extensive tract of forest. Although sharp-shinned hawks are observed (particularly when foraging) in areas having a mix of forested and semi-open habitat, they more frequently occur in forested tracts and are considered forest interior birds (Hamel, 1992). In May 2000, a sharp-shinned hawk nest was observed in a mature yellow pine tree in the Big South Fork National River and Recreation area, which is near the Daniel Boone National Forest (L.Perry, pers. obs.)

Bachman's Sparrow – *Aimophila aestivalis* – This species typically requires dense grassy places where scattered trees or saplings are present, usually in pine forests (Hamel, 1992). Historically, it was found in mature to old growth southern pine woodlands subject to frequent growing-season fires (NatureServe, 2001). This provided the grassy undergrowth required by this species. This species formerly inhabited a variety of early successional habitats in Kentucky (Palmer-Ball, 1996). Only habitats that have been frequently burned and have developed a grassy understory would be expected to support this species and most often, on the Daniel Boone National Forest, these are the drier mixed pine-oak sites.

Chuck-will's Widow – *Caprimulgus carolinensis* – This species tends to favor mixed oak and pine stands (DeGraaf et. al., 1991). It may occur and breed in general woods and forests that are primarily dry or mesic (Hamel, 1992). It appears to be much more common in drier forest where the understory and midstory levels are relatively open (Palmer-Ball, 1996). It typically feeds over adjacent fields and clearings (Hamel, 1992). Only forested habitats that have developed an open understory, generally thru repeated burning, would be expected to support this species and most often, on the Daniel Boone National Forest, these are mixed pine-oak sites.

Eastern Wood Pewee – *Contopus virens* – This species preferred habitat is rather open mature woodland in a rather dry situation (Hamel, 1992). This species may be absent from younger, second growth forest where an open midstory has not yet developed. In such habitat they often frequent edges and road or stream corridors (Palmer-Ball, 1996). They typically utilize large deciduous trees for the nest site but may use conifers in mixed forest types. This species may be found in numbers in most major forest types examined in Kentucky (Mengel, 1965). This species would be primarily attracted to the hardwood component of this habitat association when combined with dryness and upland situations.

Cerulean Warbler – *Dendroica caerulea* – This species would be primarily attracted to the hardwood component of mixed pine-oak stands. Cerulean warblers depend primarily on extensive tracts of mature, relatively undisturbed, deciduous forest. These birds occur in floodplains and upland sites that have large trees (> 20" dbh) in which to nest. Both nesting and foraging take place in the canopies of hardwoods. Stands are usually somewhat open, with little understory; however, according to Buehler and Nicholson (1997), monitoring data suggests that breeding territories in the Cumberland Mountains tend to have fewer canopy trees and greater shrub coverage than those elsewhere. The birds are rarely found in tracts less than 250 hectares, whereas maximum population densities occur in tracts greater than 3000 ha (Buehler and Nicholson 1997). Hamel gives a minimum tract size of 1750 ha (1992).

Prairie Warbler – *Dendroica discolor* – This species would be particularly attracted to the pine component of this habitat association. Prairie warblers occur in semi-open, early successional, and woodland habitats. Mixed forest type, especially those that have been cut-over or burned, with pines and cedars are occupied. Forest edges, clearings, brushy borders, and overgrown fields with scattered saplings or small trees are commonly used. On the Daniel Boone National Forest, the birds are nearly always found in early successional habitat, especially young clearcuts and the undergrowth of shelterwood cuts, wood edge, and in stands that have been burned (L. Perry, pers. obs.).

Yellow-throated Warbler – *Dendroica dominica* – This species would be attracted primarily to the pine component of mixed pine-oak forest. These warblers require extensive tracts of mature pine and pine-hardwood forests. In some areas, hardwood-pine is used; however, birds on the Cumberland Plateau show a preference for pine (Mengel 1965). Sites may range from moderately moist to dry/upland, provided the stands are rather open and have large trees (> 20" dbh). On the Daniel Boone National Forest, the birds are frequently observed in mature pine trees, and almost always observed in or near pines; they are frequently seen in stands with open canopies (L. Perry, pers. obs.).

Blackburnian Warbler – *Dendroica fusca* – This is a forest interior species of higher elevations, with most of the birds that are recorded in the Cumberland and Southern Appalachians occurring above 3500 feet. A variety of coniferous and mixed forest types are utilized, with deciduous habitat being used to a greater extent in this southern part of the breeding range. Extensive tracts of mature forest, with large (> 20"dbh) nesting trees, are required. Because of its affinity for conifers, on the Daniel Boone National Forest, this species may be occasionally encountered during periods of migration in mature stands containing pines but would not be expected to breed in these stands except in areas where elevations are greater than 3500', of which there are few of.

Pine Warbler – *Dendroica pinus* – This species would be attracted primarily to the pine component of mixed pine-oak forest. Pine warbler habitat consists of open to fairly dense stands of yellow pine and pine-hardwood. Although most numerous in extensive pine stands, the birds will use small stands of pine, as well (Mengel 1965). Suppression of fire has contributed to reduction of pine in some areas (Palmer-Ball 1986). Both middle-aged and mature stands are used; however, nesting is usually in mature pines.

Least Flycatcher – *Empidonax minimus* – This is a species of open conditions; it is rarely encountered deep in the forest. Open, deciduous woods (particularly those that have been

disturbed by burning or logging), forest edge, fields with scattered large trees, and other habitats that provide early successional conditions are utilized. During spring migration, Mengel (1965) observed male birds in alders and willows in a marshy, Laurel County meadow. Most of the breeding population frequents elevations above 2500 feet. The least flycatcher would be attracted to those mixed pine-oak habitats that have been repeatedly burned, and provide a rather open condition with an early successional understory.

Acadian Flycatcher – *Empidonax virescens* – This species is usually found near water generally near a stream course or some small waterway (Hamel, 1992). It generally uses an open, moderate understory for feeding in a stand with tall trees and closed canopy (DeGraaf et. al., 1991). It is associated with forested tracts at least 37 hectares (91.4 acres) in size (Hamel, 1992). Daniel Boone National Forest monitoring data indicates that the greatest number of occurrences for this species were in mesophytic-cove habitats greater than 80 years old. Assuming streams are nearby, this species would be attracted to those pine-oak forests where more mesic, shaded and damp conditions exist.

Worm-eating Warbler – *Helmitheros vermivorus* – Worm-eating Warblers inhabit moist, shady forest on moderate to steep slopes. In eastern Kentucky, the birds are common on deeply shaded slopes in mixed mesophytic woods and moist ravines (Mengel 1965). They are usually found in fairly mature deciduous or mixed forest with a dense understory, preferably of rhododendron and Mountain Laurel, but will also use younger forest and forest edge. Nesting is typically on sloping ground among leaf litter, while foraging is carried out on the ground or among understory vegetation. Although the species occurs in dissected woodland, it avoids isolated tracts (Palmer-Ball 1986). Hamel (1992) lists the minimum necessary tract size as 370 ha. This species would be attracted to the hardwood component of this habitat association, where conditions remain rather mesic.

Wood Thrush – *Hylocichla mustelina* – The wood thrush is found in a wide variety of forest types, provided a well-developed understory is present. Moderately shaded, deciduous and mixed stands of mature trees with a dense shrub and/or sapling understory are typical habitat, particularly when occurring on moist sites. Rich hardwood and bottomland forests are favored; however, drier sites may be used, so long they have the relatively dense shrub layer. Nesting is in shrubs, vines, and small trees. Although the species will tolerate some fragmentation of habitat, it is most common in extensive forest and requires a minimum tract size of 3 hectares (Hamel 1992). This species would be attracted to the hardwood component of this habitat association, where conditions remain rather shaded and somewhat mesic.

Swainson's Warbler – *Limnothylpis swainsonii* – This forest interior species is found within tracts of moist, extensive forest that have dense understory (Palmer-Ball, 1996). Hemlock ravines, having dense growths of rhododendron and laurel, and bottomland forest, with a well-developed understory and/or thickets of small trees, are favored locations. Dense cane breaks are also used. On the Daniel Boone National Forest, this bird is often observed in damp, shady hemlock ravines with an understory of rhododendron, near small streams (L.Perry, pers. obs.). Assuming streams are nearby, this species would be attracted to those pine-oak forests where more mesic, shaded and damp conditions exist.

Red-headed Woodpecker – *Melanerpes erythrocephalus* – Semi-open to open habitat with an abundance of large (> 14"dbh), dead trees is preferred for both breeding and wintering purposes. Relatively open, mature woods, swamps, clearings within mixed woodland, forest edges, and places where groves of trees are present, such as park-like settings, are commonly used. On the Daniel Boone National Forest, the birds are often observed in pine-dominated stands that have been frequently burned (L. Perry, pers. obs.). Nesting is in dead trees, or in dead limbs of live trees (Mengel 1965). This species generally avoids mature closed canopy forest during the breeding season (Palmer-Ball 1986). Only forested habitats that have developed an open understory, generally thru repeated burning, would be expected to support this species and most often, on the Daniel Boone National Forest, these are mixed pine-oak sites.

Kentucky Warbler – *Oporonis formosus* – Kentucky warblers are most frequent in moist, shady, deciduous and mixed (with pine or hemlock) forest types with dense, shrubby understory. However, in eastern Kentucky, they occur in virtually all major associations except the most xeric pine and pine-oak communities, and may even invade them (Mengel 1965). Mature stands are required, though some younger stands and shrubby woodland borders are used, as well. These ground-nesting birds forage in understory vegetation, leaf litter, and soil. By providing a well-developed shrub layer, many tracts disturbed by selective logging are suitable for nesting even though the canopy has been disrupted (Palmer-Ball 1986). In general, these birds have adjusted better to landscape disturbance than other woodland warblers. This species would be attracted to the hardwood component of this habitat association, where conditions remain rather shaded and somewhat mesic.

Red-cockaded Woodpecker – *Picoides borealis* – This species would be attracted primarily to the pine component of mixed pine-oak forest. Habitat for this species is generally thought of as being primarily open pine woods. Nesting habitat is generally fairly mature pine trees with little or no midstory. The birds prefer conditions of minimal understory (Hamel, 1992). It is likely that the red-cockaded woodpecker used forests that were maintained by natural fires (Palmer-Ball, 1996). On the Daniel Boone National Forest this species seems to be attracted to open, frequently burned pine dominated stands where it selects live mature pine trees for nesting (L. Perry, Pers. Observation). These stands contain cavity trees that typically range in age from 90 to 128 years old and have an average diameter at breast height of 14.2-18.9 inches (Murphy, 1980). Due to southern pine beetle impacts to the primary habitat of this species, all known red-cockaded woodpeckers on the Daniel Boone National Forest were relocated out of state to suitable habitat in other populations.

Summer Tanager – *Piranga rubra* – This species would primarily be attracted to the oak component of mixed pine-oak stands for nesting purposes and the openness frequently found with sites that are frequently burned, which, on the Daniel Boone National Forest, are generally mixed pine-oak sites. Relatively dry sites, which tend to produce stands of a semi-open condition, are frequented by this species. Uplands are commonly used, but the birds may occur in a variety of habitats, including bottomlands and wooded residential areas. Forest types range from hardwood to pine-hardwood stands of open to medium density. On the Daniel Boone National Forest, the birds are frequently found in mature, mixed pine stands that have been burned and undergone midstory removal (L. Perry, pers. obs.). Oaks are often chosen for nesting, in open woodland or forest edge and often over open spaces such as roads and clearings (Mengel 1965).

Ovenbird – *Seiurus aurocapillus* – Ovenbirds would be attracted to the hardwood component of mixed pine-oak sites and prefer areas with lots of leaf litter (DeGraaf, Scott et. al. 1991). Mature and second growth forest conditions are utilized, on dry to moderately moist sites with light to moderate understory. Ovenbirds are more common in stands with closed canopies and open ground. This is a ground nesting species that forages in the leaf litter or on the soil. Mengel (1965) observed nests on logging roads and under small logs, sheltered by ferns, on steep, mesophytic slopes; however, Baker and Lacki (1997) note that birds are more abundant in non-harvested than in harvested areas. Upland stands and sloping terrain are preferred, but a variety of deciduous and mixed (e.g., pine-oak) forest types are used. This is a forest interior species having a minimum necessary tract size of 15 ha (Hamel 1992).

American Redstart – *Setophaga ruticilla* – This species typically utilizes younger forest and forest in early to mid stages of succession (Palmer-Ball, 1996). It usually occurs near water or streams preferring moist situations to dry ones (Barbour et. al., 1973) (Hamel, 1992). American redstarts occur in altered forest situations including selectively logged areas (Palmer-Ball, 1996). Daniel Boone National Forest monitoring data indicates this species is most common in forests 41 to 80 years old. Assuming streams are nearby, this species would be attracted to the hardwood component of these mixed stands where more mesic, shaded and damp conditions exist.

Red-breasted Nuthatch – *Sitta canadensis* – This species would be attracted primarily to the pine component of mixed pine-oak forest. Though this nuthatch is dependent on coniferous habitat, its requirements vary considerably between seasons. It generally breeds at elevations above 3500 feet, in dead spruce or fir trees. Occasionally, it will nest in hemlock and, rarely, in pine (Hamel, 1992). Suitable snags (dead trees) are greater than 6”dbh (six inch diameter at breast height). Mature stands are favored. The red-breasted nuthatch prefers to over-winter in dense stands of conifers and pine-oak. During that time, the birds are not particular to age class so much as to stand density. On the Daniel Boone National Forest, when these birds are encountered in winter, it is almost always while feeding in pines—especially mature Virginia pines having a lot of cones. Breeding records of this species have only been reported from one site on the Daniel Boone National Forest, which is a conifer-dominated stand composed of mature white pines and hemlock and less mature deciduous hardwoods.(L. Perry, pers. obs.).

Yellow-throated Vireo – *Vireo flavifrons* – Extensive tracts of relatively mature woodland are necessary for this interior breeding bird. Large, deciduous trees within a variety of forest types, including mixed mesophytic cove, pine-oak, and oak hickory upland forest, are favored. Isolated or much-dissected tracts are avoided; however, the bird will tolerate a certain amount of disturbance (from fire, selective logging) without being dramatically affected (Palmer-Ball, 1996). Rather, activities that serve to result in a fairly open midstory/understory can be beneficial, as the birds’ frequent trees within relatively open settings. Yellow-throated vireos on the Daniel Boone National Forest are often observed in mixed pine-hardwood stands that have been burned or had midstory reduction (L.Perry, pers. obs.). This species would be attracted primarily to the hardwood component on this habitat association. Forested habitats that have developed an open understory, generally thru repeated burning, would be expected to support this species and most often, on the Daniel Boone National Forest, these are mixed pine-oak sites.

Insects

Appalachian Grizzled Skipper – *Pyrgus wyandot* – In Kentucky, Appalachian grizzled skipper is only known from eastern shale barrens in Harlan County. Elsewhere it is known to occur in open areas near woods, including valley bottoms, barrens, meadows, grassy hillsides and scrub oak openings. Its food sources include wild strawberry, Canadian cinquefoil, blueberry, and plants belonging the rose family.

Diana Fritillary – *Speyeria diana* – On the Daniel Boone, Diana fritillary is found in open areas and within the forest especially those that are open and well-lit. These conditions mimic open prairies and pine barrens from which the species is known out west and may be found along grassland/forest edge or in forests that have been maintained in an open condition by repeated fires. The caterpillar feeds almost exclusively on violets and winters above-ground, making them sensitive to spring and fall fires. Midstory removal and prescribed fire can create high quality foraging habitat for adults by increasing nectar sources. A variety of species are used, including common and swamp milkweeds, ironweed, red clover, coneflowers and butterfly bush. Individuals will use small openings and roadsides along forest edges in search of nectar plants, but do not go far from the woods.

Regal Fritillary – *Speyeria idalia* – The regal fritillary was once considered common in the natural grasslands, pastures and wet meadows of the northeastern United States. In the mid-west, fire-maintained oak-pine barrens supplied significant amounts of habitat for the regal fritillary. Food sources include violets, milkweeds, thistles, and other nectar producers. This species is now considered to be extirpated from Kentucky.

Reptiles

Northern Coal Skink – *Eumeces anthracinus anthracinus* – The Appalachian population of this subspecies extends into eastern Kentucky, while a disjunct population occurs in the west-central part of the state. Suitable habitat includes damp forests of oak, oak-poplar, oak-hickory-pine, and mixed pine-hardwood with moist soils, abundant leaf litter, logs, and/or loose stones; humid wooded or rocky hillsides; rocky bluffs; and similar areas near water sources, such as streams, springs, swamps, and bogs. These skinks seek the cover of rocks, logs, stumps, brush, and rock slabs. When pursued, they will take refuge in shallow water, hiding under rocks at the bottom. Various rocky areas in which they have been found include: on limestone ledges; in dry leaves beneath rock ledges; beneath flat slabs of sandstone; under rocks in sunlit forest openings and in grassy cut over areas in hardwoods; and under rocks in the slope of a road cut through a mixed forest (VA Dept. of Game and Inland Fisheries 2001). Use of fire to maintain grassy openings within forested stands is of benefit to this species. Coal skinks feed primarily on insects and spiders.

Southern Five-lined Skink – *Eumeces inexpectatus* – The southern five-lined skink ranges from Virginia south to the Florida Keys, and westward to the Mississippi River. This skink is most abundant in dry habitats, such as pine clearings, beaches, ridge tops and well-drained, sandy places. This species has been documented around man-made structures, field and wood edges, urban woodlots, dry pine forests, mixed pine-hardwood forests, early stages of lowland pine communities and sawdust piles. (Virginia website.) This skink is considered terrestrial and

arboreal. The southeastern five-lined skink diet consists of a variety of arthropods. (Wilson, 1995)

Eastern Slender Glass Lizard – *Ophisaurus attenuatus longicaudus* **–** This is a species of dry, often sandy, soil conditions. It occurs in relatively open, typically upland, habitats--including Virginia and shortleaf pine and pine-oak stands, forest edges, grassy fields and prairies--which have loose, friable soils. This secretive, legless lizard tends to stay in old rodent burrows and under mats of dead grass and decomposing plants; when it basks in the sun, it is often hidden in tall grass or with only part of its body showing (VA Dept. of Game and Inland Fisheries 2001). slender glass lizard diets include insects, spiders, birds' eggs, smaller lizards, and snakes. Prescribed burning and other management practices that help to create open canopy conditions benefit this lizard species.

Northern Pine Snake – *Pituophis melanoleucus melanoleucus* – Pine snakes inhabit dry, sandy pine and pine-oak forest types with open canopies and patchy to dense ground cover. Eastern Kentucky sites are typically upland or ridgetop, whereas, at lower elevations, the snakes utilize pine flatwoods and sandhill areas. Forest openings with scattered areas of well-drained sand and little shrub cover are required for nesting and hibernation sites (NatureServe, 2001). These secretive snakes spend much of their time in burrows, emerging to hunt for small mammals, birds and eggs; they climb trees well. Loose or friable soil is needed, since the snakes excavate their own burrows as well as use those made by small mammals. This species requires a relatively large area in which to forage (Wilson 1995). Management practices, including midstory control and prescribed burning, which serve to promote and maintain barrens-like conditions—open stands with well-lit, grassy understories—are necessary to support the species.

Southeastern Crowned Snake – *Tantilla coronata* – The southeastern crowned snake ranges from southcentral Virginia and southern Illinois to the Florida panhandle and eastern Louisiana. This secretive snake is an excellent burrower, spending much of its time concealed in rotting logs, under bark, stones, leaf litter, pine needles, or burrowed in the soil. The southeastern crowned snake apparently prefers relatively xeric, well-drained soils in pine flatwoods, sandhills and dry hillsides. This snake requires dry habitats with friable soil and sufficient debris for shelter. Females deposit eggs in rotting logs or sawdust piles. The southeastern crowned snake's diet consists of centipedes, spiders, termites, and other small, soft-bodied arthropods. (Wilson, 1995).

PLANTS

Dicots

Eastern Silvery Aster – *Aster concolor* – This aster is a coastal plain species where it is found in pine savannas. On the Daniel Boone National Forest, it is found in open yellow pine or yellow pine-oak forest that has a sparse midstory and a grass-forb ground layer. It is also found in and at the edge of warm season grassland areas, including powerline rights-of-way. It requires high light conditions and benefits from the application of fire to its habitat.

American chestnut -- *Castanea dentata* – American chestnut is far less common today than it

once was. A fungal disease introduced from Asia in 1904 decimated the species in about 30 years. The species sprouts prolifically and sprouts are still found through its range. American chestnut once dominated much of what is now upland oak forest. On what is now Daniel Boone National Forest land, American chestnut was found on narrow sandstone and conglomerate ridges along the edge of the escarpment and in the Redbird area. It was associated with chestnut oak. Scarlet and black oaks replaced it on these sites. Today, on the Daniel Boone National Forest, sprouts are common to scarce on upper slopes and ridges near the escarpment and on portions of the Redbird District. The species grows on acid soils that are generally poor, dry, and located on sites subject to fire. It is believed that fire promoted the species.

Chinquapin – *Castanea pumila* (generic) – The chinquapin occurs in upland hardwood forest. It is usually found on dry sites, and usually under a partially open canopy. On the Daniel Boone National Fores,t the species occurs as variety *pumila*. Species-habitat relationships are discussed for this variety below.

Allegheny Chinquapin – *Castanea pumila* var. *pumila* – This variety is found in dry upland oak or oak-yellow pine forests. It usually occurs where midstory and shrub layers are sparse, or the canopy is open. The species is at least somewhat adapted to fire, sprouting readily after fire. It may respond to fire in the way American chestnut and oaks do.

Scarlet Indian Paintbrush -- *Castilleja coccinea* – Scarlet Indian paintbrush is found in warm season grasslands, open upland hardwood or pine forest and occasionally along roadsides. The species requires moderate to high levels of light. It responds favorably to fire, which helps to maintain the species habitat.

Small-flowered Thoroughwort -- *Eupatorium semiserratum* – Small-flowered thoroughwort is a coastal plain species that extends into prairie regions and open forest of the Cumberland Plateau. It is rare in Kentucky and known only from one location on the Daniel Boone National Forest. Here it occurs in an open area in an oak-yellow pine forest on well-drained soil.

Box Huckleberry – *Gaylusaccia brachycera* – This huckleberry is a central Appalachian species. It occurs in upland yellow pine and yellow pine-oak woods. Yellow pine is present in or adjacent to all sites on the Daniel Boone National Forest. It is also found on sandstone glades and in the upland portions of utility rights-of-way. The species appears to require well-drained, sandy soils. Box huckleberry will grow in closed canopy (yellow pine) conditions if the midstory and shrub layers are more or less absent. On the Daniel Boone National Forest, the densest, and apparently the healthiest populations, are found in these sites. It also grows under more open canopy conditions where it is tolerant of thicker midstory and shrub layers. The rhizomes are positioned at the transition between the duff and mineral soil. Fire maintains the general habitat in which it grows. The species is top killed by fire, but does resprout, at least if the duff layer is not removed. Recovery appears to be slower than for other *Gaylusaccia* species or *Vaccinium* species, but with the proper interval and intensity of fire, populations should be maintained while enhancing habitat.

Red-disked Sunflower -- *Helianthus atrorubens* – This sunflower is a southern and prairie species commonly occurring in warm season grassland. It also is found in open yellow pine

forest. On the Daniel Boone National Forest, this species is most abundant in warm season grassland. This habitat in powerline rights-of-way holds most of the Daniel Boone National Forest population. Scattered plants and clumps are found in open yellow pine and yellow pine-oak forest. Fire enhances flowering of this species and maintains its habitat.

Smooth Veiny Peavine – *Lathyrus venosus* – This is widespread in eastern North America. It is often found in open dry forest, but may also be found in moist mesic or terrace forest, and sometimes on stream banks. On the Daniel Boone National Forest, it is found in dry-mesic oak and mixed mesophytic forest, often near gaps or other areas of higher light levels.

Carolina Anglepod – *Matelea carolinensis* – This is a coastal plain species with range extensions along the southern Appalachian Plateaus. It grows in moist, open forest, either yellow pine or hardwood, and in sandy old fields and waste areas. On the Daniel Boone National Forest, the single station is on a sandy roadside adjacent to open yellow pine-oak forest.

American Cow-wheat – *Melampyrum lineare* (generic) – American cow wheat has a taxonomy somewhat confused with numerous uses by various authors. Following Medley (1993), only the var. *pectinatum* is likely to present on the Daniel Boone National Forest. Specimens not identified to variety from the Daniel Boone National Forest area are assumed to be this variety. Habitat details are described below for the variety.

American Cow-wheat -- *Melampyrum lineare* var. *pectinatum* – This variety has been carried as var. *lineare* on the Daniel Boone National Forest based on a literature citation. Medley (1993) argues against this and places all plants in the Daniel Boone National Forest area in var. *pectinatum*. This is a coastal plain species. It is found in sandy, open yellow pine forest. On the Daniel Boone National Forest, the sole station for the species is from ridgetop dry-xeric oak and oak-yellow pine forest.

Sweet Pinesap – *Monotropsis odorata* – Sweet pinesap is a central and southern Appalachian provinces species. It is saprophytic, gaining carbohydrate nutrients from associations with soil fungi. The species appears to be associated with ericaceous shrubs and or yellow pine in dry forest. It is usually found in or at the base of dense thickets of *Rhododendron maximum*, *R. catawbiense*, or *Kalmia latifolia*, usually with yellow pine, but sometimes with upland oaks. Populations on the Daniel Boone National Forest are found in similar habitat with the exception of one or two which are moist micro-habitat associated with shaded cliffs. Fire likely is important to the maintenance of the community in which *Monotropsis* lives and is unlikely to harm the species as it occurs mostly underground except for flowering.

Gaywings – *Polygala pauciflora* – Gaywings is a northern species with extend range through the southern Appalachians. It is found in rich moist forest. On the Daniel Boone National Forest, one station is known from a mesic ravine in oak-hardwood forest.

Racemed Milkwort – *Polygala polygama var. polygama* – This milkwort has a midwestern and coastal plain distribution. It is usually found on dry, sandy soil in open forest or grassland. The Daniel Boone National Forest sites are on sandy soil in open, ridge top, yellow pine-oak forest or sandy, grassy openings.

Hairy Snout Bean – *Rhynchosia tomentosa* (var. *tomentosa*) – Hairy snout bean is found throughout most of the southeastern US. It grows in dry, open, often sandy, oak or yellow pine forest, at forest margins, in sandhills, and occasionally in mesic forest. The Daniel Boone National Forest sites are all in warm season grassland, or low disturbed vegetation along roads or under powerline rights-of-way.

Slender Marsh-pink – *Sabatia campanulata* – This is coastal plain species found in salt or brackish marshes. It occurs inland in a few areas. The Daniel Boone National Forest sites are from wet meadows.

American Chaffseed – *Schwalbea americana* – American chaffseed occurs in two general kinds of habitats, wet and dry. In all cases, soils are sandy and somewhat sterile. In wet habitats, the combination of constant water and periodic fire maintain the site in an open condition. The overstory is open as are the midstory and shrub layers beneath it. Generally wet sites are grassy with few shrubs. Periodic fire helps to maintain the open condition of the sites. It also plays a role in triggering flowering. This habitat type is not known from the Daniel Boone National Forest. Dry habitats likewise are open with a thin overstory and open midstory and shrub layers. These sites are generally a mixture of forbs, grasses, and low shrubs. Some dry habitats are subjected to periodic burns, which help to maintain the open condition. Fire here also helps to trigger flowering. In other dry habitats, the openness is more edaphically controlled. The historic sites on the Daniel Boone National Forest fall into this group. Here fire would have triggered flowering. Other dry Daniel Boone National Forest sites could, with periodic fire, support *Schwalbea* populations.

Big-flowered Snowbell – *Styrax grandiflorus* – Big-flowered snowbell is a southern Appalachian Mountains and southeastern coastal plain species. It commonly grows in mixed or deciduous forest in upland locations. There is at least one reliable record for the species in Kentucky from the Daniel Boone National Forest area (McCreary County). Here is growing in mixed mesophytic forest on a north aspect above the Cumberland River.

Spiked Hoary-pea – *Tephrosia spicata* – Spiked hoary pea is a southern species with a number of more northern stations. In is commonly found in dry to wet, open yellow pine or yellow pine-hardwood forest, roadsides, clearings and fields. On the Daniel Boone National Forest, the species is found on boulder/cobble bars along larger streams and rivers of the Cumberland River drainage. A few sites are known from sandy, sparsely shaded openings on ridges.

Bird's-foot Violet -- *Viola pedata*- Bird's foot violet occurs in dry, well-drained soils. On the Daniel Boone NF, it is most frequently encountered along sandy roadbanks and slopes in open yellow pine or yellow pine-oak forests. High light levels appear to be required by the species. The species also occurs in dry, upland pastures or grassy slopes that have thin vegetation.

Gymnosperms

Ground Juniper – *Juniperus communis* var. *depressa* – Ground juniper is a northern species whose range extends into the southern Appalachians. It occurs on rocky sites, in the open or under open canopy. On the Daniel Boone National Forest, the two known sites occur on

sandstone cliff tops, rooted in rocky soil in areas of open canopy. Fire may have a detrimental effect on the species.

Pitch Pine – *Pinus rigida* – Pitch pine ranges from New England to the Appalachian Mountains. It grows in generally sterile, sandy soil where it competes well against many other woody species. These soils are usually dry, but may be moist. The cones are semi-serotinous, opening following hot fires or occasionally very hot days. Fire also prepares a seedbed advantageous to the light seeds. On the Daniel Boone NF, this species is most commonly found within a few hundred feet of sandstone cliffs. The soils here are sandy, thin and usually dry providing the conditions under which the species competes. These areas also would have been subject to periodic burning, aiding regeneration of the species.

Liverworts

Liverwort – *Nowellia curvifolia* – This liverwort is widespread in northern North America, south into the Appalachian provinces, present in the high mountains of Mexico and Central America. It is found almost exclusively on decorticated logs. On the Daniel Boone National Forest, it is found almost exclusively on decorticated eastern hemlock and yellow pine logs, usually of 10-12 inch diameter or larger. It requires moderate to heavy shade.

Monocots

Grass-pink – *Calopogon tuberosus* – Grass pink is a coastal plain species found in wet to moist pine savannas, roadside ditches, pitcher plant bogs, and other open, wetland habitats. A few historic Kentucky stations occurred in dry, sandy soil on ridgetops under open oak or oak-yellow pine forest. On the Daniel Boone National Forest, a few extant stations are known from streamhead wetlands, slope seeps or wet warm season grassland. It may have occurred on drier sites in the past. The species requires constant moisture and more or less open conditions.

Doughnut or Boott's Sedge -- *Carex picta* – This sedge is scattered across the forest. It grows in clumps, which over time, spread outward while dying in the center, leaving a doughnut-shaped ring. It was considered uncommon throughout its range until rare plant surveys on the Daniel Boone National Forest located many populations. Most of these populations are small with a few plants, but a few are large (0.4-1 ha, 1-2.5 ac). The species appears to survive in heavy shade, but does poorly. It does best under an open canopy with little midstory on slopes. This habitat is probably maintained by fire, especially since the plant appears to promote fire. The leaves contain a volatile oil, which readily allows even green leaves to burn, and old leaves form a loose mound of fine fuels around the plants.

Appalachian Spreading Pogonia – *Cleistes bifaria* – The Applachian spreading pogonia ranges from the Appalachian Plateaus to the Piedmont. It is found in a variety of sites ranging from glades to open forest to warm season grassland to streamhead wetlands. It occurs on well-drained substrates (on hummocks in wetlands) usually in open or partially open conditions. The plants can be single or occur in colonies. On the Daniel Boone National Forest, it is known from glades, streamhead wetlands, seep slopes, and on road cuts in upland oak forest. Fire enhances flowering and total numbers of plants. Fire probably helps to maintain habitat as well.

Spotted Coralroot – *Corallorhiza maculata* – Spotted coralroot is mostly a northern species with extensions into the Appalachian Mountains. Its habitat is hardwood forest, but occurs under a variety of conditions. In Kentucky, it is known only from Pine Mountain within the Daniel Boone National Forest proclamation boundary. It occurs on dry-mesic oak-hardwood forest in rich soil.

Pink Lady's-slipper – *Cypripedium acaule* – Across its range, pink lady's-slipper occurs in acid forests or wetlands (usually sphagnum bogs). On the Daniel Boone National Forest, pink lady-slipper is found in upland oak and mixed pine-oak woods, and occasionally on hummocks within seeps and streamhead wetlands. It occurs in light to heavy shade, but does not seem to flower unless in somewhat open conditions. This species responds well to burning. It is not uncommon to find 3 to 4 dozen plants in flower and as many more in vegetation condition following a fire where only a dozen or so were found before. The species is experiencing collection pressure from root diggers. Digging of this species is not permitted on the Daniel Boone National Forest.

Bearded Skeleton Grass – *Gymnopogon ambiguous* – Bearded skeleton grass is a coastal plain species that generally occurs in dry, sandy, open forest. It may also occur in open grassland. On the Daniel Boone National Forest, it occurs in open warm season grassland and open, sandy ground with or without light forest cover.

Wood Lily – *Lilium philadelphicum* var. *philadelphicum* – Wood lily occurs from New England to North Carolina and Kentucky. It is found in open, usually dry forest or in open fields or warm season grass areas. On the Daniel Boone National Forest, it is know from open yellow pine-oak forest, roadsides, warm season grassland, and old fields. It requires open conditions and is soon choked out by heavy cover of herbaceous or woody species. Fire maintains its habitat and promotes the plant.

Mosses

Dog Paw Moss or Elegant Moss – *Dicranum scoparium* – This moss is found throughout most of eastern North America. It is relatively common on shaded sandstone boulders, outcrops and cliffs. It also occurs on soil in upland forest. It appears to require moderate shade and acid conditions, but will live in moist to dry environments. The species is often subject to fire and frequently portions of clumps are burned, but not the entire clump. The species is collected for the horticultural industry. It may serve as a refugium for some species during fire events, and act as water reservoir and soil stabilizer following fire.

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Attachment C.

Dry-Mesic Mixed Pine-Oak Habitat Association Matrix

Association	Habitat	Modifier	Class	Common/Species
7-Dry-Mesic Mixed Pine-Oak	Dry-Mesic Mixed Pine-Oak Forest	(blank)	BIRD	Chuck-will's widow/ Caprimulgus carolinensis
				Eastern wood pewee/ Contopus virens
				Red-cockaded Woodpecker/ Picoides borealis
				Red-breasted Nuthatch/ Sitta canadensis
			INSEC	Regal Fritillary/ Speyeria idalia
			P-DIC	Chinquapin (generic)/ Castanea pumila
				Small-flowered Thoroughwort/ Eupatorium semiserratum
				Smooth Veiny Peavine/ Lathyrus venosus
				Carolina Anglepod/ Matelea carolinensis
				Cow-wheat/ Melampyrum lineare
				American Cow-wheat/ Melampyrum lineare var. pectinatum
				Big-flowered Snowbell/ Styrax grandiflorus
			P-MON	Pink Lady-slipper/ Cypripedium acaule
			REPT	Scarlet Kingsnake/ Lampropeltis triangulum elapsoides
				Southeastern Crowned Snake/ Tantilla coronata
		Acidic Substrate	P-DIC	Racemed Milkwort/ Polygala polygama var. polygama
			P-GYM	Ground Juniper/ Juniperus communis var. depressa
			P-MON	Pink Lady-slipper/ Cypripedium acaule
			P-MOS	Dog Paw Moss, Elegant Moss/ Dicranum scoparium
		Aspect (SE to NW)	P-GYM	Ground Juniper/ Juniperus communis var. depressa
				Pitch Pine/ Pinus rigida
		Burrows, Holes, Tunnels (Secondary Users)	REPT	Eastern Slender Glass Lizard/ Ophisaurus attenuatus longicaudus
		Closed Forest Canopy	BIRD	Acadian flycatcher/ Empidonax virescens
				Ovenbird/ Seiurus aurocapillus
		Dense shrub understory		Worm-eating warbler/ Helmitheros vermivorus
				Wood Thrush/ Hylocichla mustelina
				Swainson's Warbler/ Limnothlypis swainsonii
				Kentucky warbler/ Oporornis formosus
				Ovenbird/ Seiurus aurocapillus
		Downed Logs	REPT	Southern Five-lined Skink/ Eumeces inexpectatus
				Southeastern Crowned Snake/ Tantilla coronata
		Downed Logs (minimum size)	P-LIV	Liverwort/ Nowellia curvifolia
		Drainage Good	INSEC	Appalachian Grizzled Skipper/ Pyrgus wyandot
			REPT	Southern Five-lined Skink/ Eumeces inexpectatus
		Drainage Poor	INSEC	Regal Fritillary/ Speyeria idalia
		Dry	BIRD	Chuck-will's widow/ Caprimulgus carolinensis

Association	Habitat	Modifier	Class	Common/Species
				Summer tanager/ Piranga rubra
				Ovenbird/ Seiurus aurocapillus
			P-DIC	Eastern Silvery Aster/ Aster concolor
				Spiked Hoary-pea/ Tephrosia spicata
				Bird's-foot Violet/ Viola pedata
			P-MON	Boott's Caric Sedge/ Carex picta
				Appalachian Spreading Pogonia/ Cleistes bifaria
				Pink Lady-slipper/ Cypripedium acaule
				Bearded Skeleton Grass/ Gymnopogon ambiguus
		Elevation (above 2300 ft)	BIRD	Blackburnian warbler/ Dendroica fusca
				Least flycatcher/ Empidonax minimus
				Red-breasted Nuthatch/ Sitta canadensis
			P-DIC	Gaywings/ Polygala pauciflora
		Ericaceous Shrub Associate	INSEC	Diana Fritillary/ Speyeria diana
			REPT	Northern Coal Skink/ Eumeces antracinus anthracinus
				Southern Five-lined Skink/ Eumeces inexpectatus
				Northern Pine Snake/ Pituophis melanoleucus melanoleucus
		Fire Dependent	BIRD	Red-cockaded Woodpecker/ Picoides borealis
			REPT	Southern Five-lined Skink/ Eumeces inexpectatus
				Northern Pine Snake/ Pituophis melanoleucus melanoleucus
		Fire Tolerant/Enhanced	BIRD	Bachman's Sparrow/ Aimophila aestivalis
				Pine warbler/ Dendroica pinus
				Least flycatcher/ Empidonax minimus
				Red-headed woodpecker/ Melanerpes erythrocephalus
				Red-cockaded Woodpecker/ Picoides borealis
				Summer tanager/ Piranga rubra
				Yellow-throated vireo/ Vireo flavifrons
			INSEC	Appalachian Grizzled Skipper/ Pyrgus wyandot
				Regal Fritillary/ Speyeria idalia
			P-MON	Boott's Caric Sedge/ Carex picta
		Forb/Grass Condition	BIRD	Bachman's Sparrow/ Aimophila aestivalis
				Chipping sparrow/ Spizella passerina
			INSEC	Appalachian Grizzled Skipper/ Pyrgus wyandot
		Forest Interior (Minimal Edge)	BIRD	Sharp-shinned Hawk/ Accipter striatus
				Cerulean Warbler/ Dendroica caerulea
				Yellow-throated Warbler/ Dendroica dominica
				Blackburnian warbler/ Dendroica fusca
				Worm-eating warbler/ Helmitheros vermivorus
				Swainson's Warbler/ Limnothlypis swainsonii
				Ovenbird/ Seiurus aurocapillus
				Yellow-throated vireo/ Vireo flavifrons
		High Shade		Worm-eating warbler/ Helmitheros vermivorus
			P-DIC	Sweet Pinesap/ Monotropsis odorata

Association	Habitat	Modifier	Class	Common/Species
		Large Decadent Trees	BIRD	Sharp-shinned Hawk/ Accipter striatus
				Eastern wood pewee/ Contopus virens
				Red-cockaded Woodpecker/ Picoides borealis
		Large Decadent Trees	BIRD	Yellow-throated Warbler/ Dendroica dominica
		Leaf Litter		Worm-eating warbler/ Helmitheros vermivorus
				Ovenbird/ Seiurus aurocapillus
			REPT	Southern Five-lined Skink/ Eumeces inexpectatus
				Eastern Slender Glass Lizard/ Ophisaurus attenuatus longicaudus
		Mature forest	BIRD	Sharp-shinned Hawk/ Accipter striatus
				Eastern wood pewee/ Contopus virens
				Cerulean Warbler/ Dendroica caerulea
				Yellow-throated Warbler/ Dendroica dominica
				Blackburnian warbler/ Dendroica fusca
				Pine warbler/ Dendroica pinus
				Red-headed woodpecker/ Melanerpes erythrocephalus
				Kentucky warbler/ Oporornis formosus
				Red-cockaded Woodpecker/ Picoides borealis
				Summer tanager/ Piranga rubra
				Red-breasted Nuthatch/ Sitta canadensis
		Mid-age Forest		Eastern wood pewee/ Contopus virens
				Pine warbler/ Dendroica pinus
				American redstart/ Setophaga ruticilla
		Moderate Shade	P-DIC	Sweet Pinesap/ Monotropsis odorata
		Moderate Shade	P-MON	Wood Lily/ Lilium philadelphicum var. philidelphicum
		Moist	BIRD	Worm-eating warbler/ Helmitheros vermivorus
				Wood Thrush/ Hylocichla mustelina
				Kentucky warbler/ Oporornis formosus
			P-DIC	Sweet Pinesap/ Monotropsis odorata
			P-MON	Grass-pink/ Calopogon tuberosus
				Appalachian Spreading Pogonia/ Cleistes bifaria
				Spotted Coralroot/ Corallorrihiza maculata
		Old Growth Condition	BIRD	Red-cockaded Woodpecker/ Picoides borealis
		Open (Little or No Shade)		Summer tanager/ Piranga rubra
			INSEC	Appalachian Grizzled Skipper/ Pyrgus wyandot
			P-DIC	Purple False Foxglove/ Agalinus decemloba
				Red-disked Sunflower/ Helianthus atrorubens
				Racemed Milkwort/ Polygala polygama var. polygama
			P-MOS	Dog Paw Moss, Elegant Moss/ Dicranum scoparium
		Open Forest Canopy	BIRD	Pine warbler/ Dendroica pinus
				Least flycatcher/ Empidonax minimus
				Red-headed woodpecker/ Melanerpes erythrocephalus
				Summer tanager/ Piranga rubra
				Chipping sparrow/ Spizella passerina
			BIRD	Yellow-throated Warbler/ Dendroica dominica

Association	Habitat	Modifier	Class	Common/Species
			INSEC	Diana Fritillary/ Speyeria diana
			P-DIC	Allegheny Chinquapin/ Castanea pumila var. pumila
			P-MON	Boott's Caric Sedge/ Carex picta
				Appalachian Spreading Pogonia/ Cleistes bifaria
				Wood Lily/ Lilium philadelphicum var. philidelphicum
			REPT	Northern Coal Skink/ Eumeces antracinus anthracinus
				Southern Five-lined Skink/ Eumeces inexpectatus
				Northern Pine Snake/ Pituophis melanoleucus melanoleucus
		Open Midstory/Understory	BIRD	Bachman's Sparrow/ Aimophila aestivalis
				Chuck-will's widow/ Caprimulgus carolinensis
				Eastern wood pewee/ Contopus virens
				Cerulean Warbler/ Dendroica caerulea
				Acadian flycatcher/ Empidonax virescens
				Red-cockaded Woodpecker/ Picoides borealis
				Summer tanager/ Piranga rubra
				Ovenbird/ Seiurus aurocapillus
				Yellow-throated vireo/ Vireo flavifrons
			INSEC	Diana Fritillary/ Speyeria diana
			P-DIC	Box Huckleberry/ Gaylussacia brachycera
			P-MON	Boott's Caric Sedge/ Carex picta
			REPT	Northern Coal Skink/ Eumeces antracinus anthracinus
				Southern Five-lined Skink/ Eumeces inexpectatus
				Northern Pine Snake/ Pituophis melanoleucus melanoleucus
		Rich Soil	P-DIC	American Chestnut/ Castanea dentata
			P-MON	Spotted Coralroot/ Corallorrihiza maculata
		Riparian	REPT	Eastern Slender Glass Lizard/ Ophisaurus attenuatus longicaudus
		Rocky/Rocks	P-GYM	Pitch Pine/ Pinus rigida
			REPT	Southern Five-lined Skink/ Eumeces inexpectatus
				Southeastern Crowned Snake/ Tantilla coronata
		Sandy Soil	INSEC	Appalachian Grizzled Skipper/ Pyrgus wyandot
			P-DIC	Eastern Silvery Aster/ Aster concolor
				Racemed Milkwort/ Polygala polygama var. polygama
				Hairy Snout Bean/ Rhynchosia tomentosa
				Slender Marsh-pink/ Sabatia campanulata
				American Chaffseed/ Schwalbea americana
			P-GYM	Pitch Pine/ Pinus rigida
			P-MON	Grass-pink/ Calopogon tuberosus
			REPT	Southern Five-lined Skink/ Eumeces inexpectatus
		Shrub/Sapling Condition	BIRD	Prairie warbler/ Dendroica discolor
				Least flycatcher/ Empidonax minimus
				Ovenbird/ Seiurus aurocapillus
				American redstart/ Setophaga ruticilla
				Chipping sparrow/ Spizella passerina
			INSEC	Appalachian Grizzled Skipper/ Pyrgus wyandot

Association	Habitat	Modifier	Class	Common/Species
			REPT	Southern Five-lined Skink/ Eumeces inexpectatus
		Slope (hillside, steepness)	BIRD	Worm-eating warbler/ Helmitheros vermivorus
				Ovenbird/ Seiurus aurocapillus
		Snags > 6" dbh		Red-headed woodpecker/ Melanerpes erythrocephalus
		Tract Size (Area Sensitive)		Acadian flycatcher/ Empidonax virescens
				Cerulean Warbler/ Dendroica caerulea
				Yellow-throated Warbler/ Dendroica dominica
				Pine warbler/ Dendroica pinus
				Worm-eating warbler/ Helmitheros vermivorus
				Swainson's Warbler/ Limnothlypis swainsonii
				Ovenbird/ Seiurus aurocapillus
		Tree and Snags (Cavity Nesters)		Red-headed woodpecker/ Melanerpes erythrocephalus
				Red-cockaded Woodpecker/ Picoides borealis
		Trees > 20" dbh		Cerulean Warbler/ Dendroica caerulea
				Yellow-throated Warbler/ Dendroica dominica
				Blackburnian warbler/ Dendroica fusca
		Upland (usually mesic to dry, not subject to holding water)	BIRD	Chipping sparrow/ Spizella passerina
				Yellow-throated Warbler/ Dendroica dominica
				Ovenbird/ Seiurus aurocapillus
				Yellow-throated vireo/ Vireo flavifrons
			REPT	Southeastern Crowned Snake/ Tantilla coronata
		Water (Distance Sensitive)	BIRD	Acadian flycatcher/ Empidonax virescens
				American redstart/ Setophaga ruticilla